MECHANICAL SYSTEMS

PHYSICS **LEVEL 3**

Study Checklist

If you've picked up this checklist, congrats! You've begun the first step in a system of resources designed to help you through the Mechanical Systems external. To make the most of this, we suggest you sit down, grab a pen, and mark any points that you're feeling a little unsure of. Then, create a subject audit using our template, or refer to the page numbers to find the section in our walkthrough guide to help you out!

TRANSLATIONAL MOTION

- ☐ I can define the "centre of mass" *[TBC]*
- ☐ I can calculate the position of the centre of mass with multiple objects using the formula: $X_{cm}=(x_1 m_1+x_2 m_2+...)/(m_1+m_2+...)$ *[TBC]*
- ☐ I can describe the path of the centre of mass before and after a collision *[TBC]*
- ☐ I can explain the importance of an object's centre of mass when discussing how forces act on an object. *[TBC]*
- ☐ I can calculate the force due to gravity using the formula: $F_g=G(m_1 m_2)/d^2$ *[TBC]*
- ☐ I can define "escape velocity" and "orbital velocity" *[TBC]*
- ☐ I can describe a "geostationary satellite" *[TBC]*
- ☐ I can discuss the relationship between distance and gravitational force, and explain how the force due to gravity on Earth changes depending on how high an object is *[TBC]*
- ☐ I can calculate the orbital velocity of an object which circles the Earth *[TBC]*
- ☐ I can calculate the height needed for a satellite to be geostationary *[TBC]*
- ☐ I can state the unit AND symbol of momentum *[TBC]*
- ☐ I can calculate the momentum of an object from its mass and velocity *[TBC]*
- ☐ I can calculate the change in momentum, force or change in time from the equation: $\Delta p=F \times t$ *[TBC]*
- ☐ I can calculate the total momentum of multiple objects before a collision *[TBC]*
- ☐ I can explain the concept of "apparent weight", and compare this to "weight" *[TBC]*
- ☐ I can explain the difference between an elastic and an inelastic collision *[TBC]*
- ☐ I can calculate the velocity of an object after a collision using the total momentum before and after the collision *[TBC]*
- ☐ I can define "impulse", in terms of the momentum *[TBC]*
- ☐ I can state whether momentum is conserved or not during a collision *[TBC]*
- ☐ When two objects of known size and velocity collide and stick together, I can calculate the resulting velocity of their combined mass *[TBC]*
- ☐ I can discuss how seat belts, air bags and crumple zones in cars protect the passengers, referring to change in momentum, time and force *[TBC]*

CIRCULAR MOTION AND GRAVITY

- ☐ I can define "centripetal force" *[TBC]*
- ☐ I can draw and label a diagram of the circular motion of an object, showing the direction of the centripetal force and the velocity *[TBC]*
- ☐ I can discuss what happens to the object when the centripetal force is removed, in terms of both its speed and direction *[TBC]*
- ☐ I can calculate the centripetal acceleration (a_c), velocity (v), or radius (r) using the equation: $a_c=v^2/r$ *[TBC]*
- ☐ I can calculate the centripetal force (Fc), mass (m), velocity (v), or radius (r) using the equation: $F_c=(mv^2)/r$ *[TBC]*
- ☐ I can calculate the distance travelled in one lap by calculating the perimeter of a circle *[TBC]*
- ☐ Based on the real-world example given, I can describe what provides the centripetal force *[TBC]*
- ☐ I understand that the velocity of the object is at 90°, or tangential, to the centripetal force *[TBC]*
- ☐ I can state where on a vertical circle speed, kinetic energy and potential energy are at their maximum and minimum values *[TBC]*
- ☐ I can discuss the energy changes in vertical circular motion *[TBC]*
- ☐ When string is used to swing an object in a vertical circular motion, I can calculate the tension force of the string at various points *[TBC]*
- ☐ I can draw a free-body diagram showing the weight force and reaction force of an object on a curved bank *[TBC]*
- ☐ I can calculate the reaction force of an object on a curved bank *[TBC]*
- ☐ I can use the reaction force to calculate the velocity an object needs to travel to remain in the same circular path on a curved bank *[TBC]*

ROTATING SYSTEMS

- ☐ I can state the symbols AND units used for angular position, angular velocity, angular acceleration, inertia, and momentum *[TBC]*
- ☐ I can convert radians per second to revolutions per minute, and vice versa *[TBC]*
- ☐ I can define "inertia".
- ☐ I can calculate torque using the equations: $\tau=F\times d$ OR $\tau=I\times\alpha$ *[TBC]*
- ☐ I can describe angular momentum in terms of inertia and angular velocity *[TBC]*
- ☐ I can calculate the rotational kinetic energy of an object *[TBC]*
- ☐ I can explain why a solid object will have a greater rotational kinetic energy than a hollow object of the same mass, and therefore why the solid object will move faster *[TBC]*
- ☐ I can explain how angular velocity of a rotating system can be increased or decreased *[TBC]*
- ☐ I can link linear momentum with angular momentum *[TBC]*

OSCILLATING SYSTEMS

- ☐ I can list examples of simple harmonic motion *[TBC]*
- ☐ I can describe periodic, or harmonic, motion *[TBC]*
- ☐ I can define the time period in simple harmonic motion, and calculate its value using $T=2\pi/\omega$ *[TBC]*
- ☐ I can calculate the time period for a pendulum using $T=2\pi\sqrt{(l/g)}$ *[TBC]*
- ☐ I can calculate the time period for a spring system using $T=2\pi\sqrt{(m/k)}$ *[TBC]*
- ☐ I can explain how the time period can be increased or decreased in simple harmonic motion (and in a pendulum or spring system) *[TBC]*
- ☐ I can calculate the displacement, velocity and acceleration of an object in simple harmonic *[TBC]*
- ☐ motion at a specific time from starting in the middle *[TBC]*
- ☐ I can calculate the displacement, velocity and acceleration of an object in simple harmonic motion at a specific time from starting at one of the ends of the motion *[TBC]*
- ☐ I can describe the process of dampening in oscillating systems *[TBC]*
- ☐ I can explain how resonance occurs in simple harmonic motion *[TBC]*
- ☐ I can explain the relationship between kinetic energy and potential energy in a simple harmonic system *[TBC]*